INSTRUCTION MANUAL

MODEL 4111
POSITIONER CONTROL UNIT

SCIENTIFIC-ATLANTA, INC.

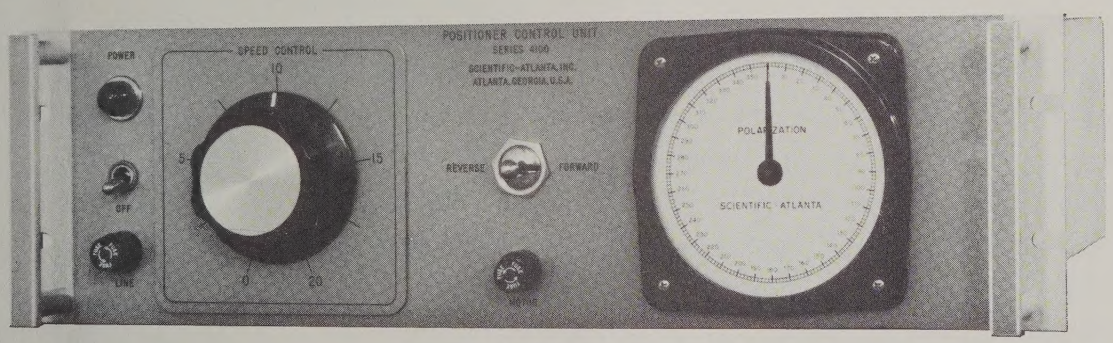
When ordering parts from Scientific-Atlanta, Inc., be sure to include the equipment model number, equipment serial number, and a description of the part.

MODEL NO. 4111 — 4404 MOD

SERIAL NO. 261 — 1403

INSTRUCTION MANUAL

MODEL 4111
POSITIONER CONTROL UNIT



P-603

This manual is applicable to Positioner Control Unit Serial No. 48 and above.

Second Edition
December 1965

MODIFICATION NOTICE

MODEL 4111-4404 MOD POSITIONER CONTROL UNIT, SERIAL NO. 261

This positioner control unit has been modified from the standard unit described in this instruction manual. A full-wave dc series-regulated power supply and a DRIVE SELECT switch have been added. These components are used in conjunction with the photoelectric limit sensor subassembly on the positioner.*

Operation of the circuit is as follows: When the DRIVE SELECT switch is set to the VARIABLE position, the speed of the positioner may be varied as described in this instruction manual for the standard unit. When the DRIVE SELECT switch is placed in the CONSTANT DRIVE position, a fixed 13V dc voltage is fed into the positioner from the regulated dc supply.

CAUTION

Do not change the position of the DRIVE SELECT switch while the positioner is running. Damage to the dc power supply may result.

Each of four lines from the photo silicon controlled rectifiers (PSCR) in the positioner limit sub-assembly is brought into the positioner control unit. These lines are fed directly to the customer-supplied control panel. A switch in this control panel connects one of the lines to a relay and dc power supply. As a hole in the light-chopper disc permits light to strike the PSCR, the PSCR conducts and energizes the relay. When the relay pulls in, the dc drive voltage supplying the positioner is broken and dynamic braking is applied through a 5Ω resistor. When the switch on the customer-supplied control panel is changed to another position, the PSCR is reset and the relay drops out to allow the positioner to start driving again.

See Dwg. 55631 for the positioner control unit schematic diagram.

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*Model 5613-S1-R/81460--see separate instruction manual.

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INSTRUCTION MANUAL
CHANGE NOTICE

MODEL 4111, SECOND EDITION, DECEMBER 1965

To make this manual apply to your instrument, make the manual changes shown below.

Instrument Serial No.	Change
All	Errata

Instrument Serial No.	Change

Errata: On page 5-2, the part number of diodes CR-1 through CR-4 is 1N2484. The description of connector P-3 should be changed to "male, 8 pins."

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CHAPTER 1
GENERAL DESCRIPTION

1.1 Introduction

The Scientific-Atlanta Model 4111 Positioner Control Units allow remote control of the speed and direction of dc motor-operated devices where a compact, single-axis control unit is desired. The 4111 is suitable for use in the smaller instrumentation installation where the greater versatility of a multiaxis control unit is not required. An optional Scientific-Atlanta Series 4400 Indicator Unit can be installed in the unit to provide remote position indication. The control-indicator combination is designated the Model 4111-440( ).

1.2 Specifications

Positioner Control Unit

Maximum Motor Size	3/4 horsepower, dc shunt, continuously; up to 1 horsepower with a 50% duty cycle
Input Power	115 volts rms ±10%, 50/60 cps, 1ϕ, 1000 watts full load, 70 watts standby
Output Power	
Armature Voltage	0-120 volts dc, continuously variable
Armature Current	6.5 amperes maximum continuous; 8.5 amperes with 50% duty cycle ("on" period less than 10 min.)
Field Voltage	105 volts dc, fixed
Field Current	0.6 ampere max., continuous
Dimensions	Standard 19-inch EIA panel 5-1/4 inches high. Chassis is 12 inches deep
Weight	
Net	19 pounds
Shipping	25 pounds

Indicator Unit

Accuracy	
Models 4402, 4403, 4405, and 4406	±0.03 degree
Models 4401 and 4404	±1 degree
Synchro Receiver	23TR6 (115/90v)
Dimensions	4-3/4 inches high, 4-3/4 inches wide, 6-1/2 inches deep
Weight	
One-Synchro Model	3-1/2 pounds
Two-Synchro Model	5 pounds

CHAPTER 2
INSTALLATION

2.1 Installation

The positioner control unit may be installed in any position. All connections are made through type MS connectors located on the rear of the chassis. Refer to the schematic diagram at the back of this manual for pin connections.

2.1.1 Limit Switch Option

It is possible to drive an antenna positioner when limit switches are not used on the positioner. For operation without limit switches, connect jumpers on terminal board TB-2 between terminals 1, 2, and 3.

2.1.2 Fuses

Install a type 3AG (slow blow) or 3AB (medium lag) fuse according to the following table. (When in doubt, see the motor nameplate.)

CAUTION

Always check both fuses for proper size before operating the equipment for the first time.

Table 2.1. Fuse Selection Chart

Motor Size* (hp)	Line Fuse, F-1**	Motor Fuse, F-2
3/4	10a, 3AB	8a, 3AB
1/2	10a, 3AB	6a, 3AB
1/3	5a, 3AG, SB	4a, 3AG, SB
1/4	4a, 3AG, SB	3a, 3AG, SB
1/8	3a, 3AG, SB	2a, 3AG, SB
1/12	3a, 3AG, SB	1.5a, 3AG, SB
1/15	3a, 3AG, SB	1a, 3AG, SB
1/20	3a, 3AG, SB	0.75a, 3AG, SB
1/40	3a, 3AG, SB	0.75a, 3AG, SB
1/50	3a, 3AG, SB	0.5a, 3AG, SB

*115v dc, 1725/1750 rpm, shunt-wound.
**May need to be increased for additional synchro load; multiply total number of synchro receivers and transmitters by 0.25 for total synchro current.

2.2 Supplementary Installation Information

When it is desired to control a dc motor other than one supplied with Scientific-Atlanta equipment, the following information may prove useful in determining the proper connections to be made to the control unit. The information contained in this paragraph is of a general nature. Therefore, it is recommended that each individual motor be thoroughly investigated, and all motor terminals positively identified, before actually connecting the motor to the control unit. Relative resistance values of various motor windings are given in the diagrams on the opposite page.

The most common types of dc motors that can be operated from the Model 4111 are shunt, compound, and series.

The armature terminations, designated as A1 and A2, should be connected to the armature supply* of the control unit. The shunt-field terminals, designated F1 and F2, should be connected to the field supply* of the control unit. Direction reversal is accomplished by changing the polarity of the voltage applied to the armature winding while maintaining the field-voltage polarity constant.

The series-field winding in a compound motor is not used and should be isolated but not short-circuited. In some motors this winding is brought out to two terminals (S1 and S2) or may have one of its terminals common with the shunt field (L2 or S2-F2).

For each type of motor, the armature- and field-circuit currents should be measured. Do not allow the currents to exceed those for which the motor and the positioner control unit are rated (see paragraph 1.2).

2.3 Indicator Unit Installation

Remove the plate on the right side of the front panel and the two plates on the rear chassis apron covering the holes for connectors J3 and J4. Fasten the indicator unit to the panel using the hardware supplied.

Remove the retaining rings from the two wired connectors and remove the blue connector inserts.

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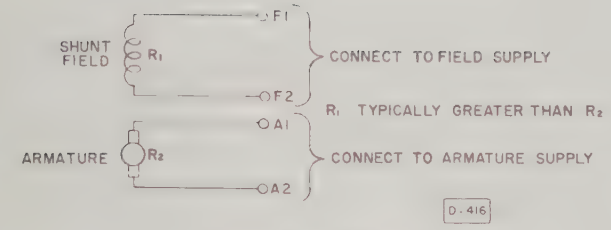
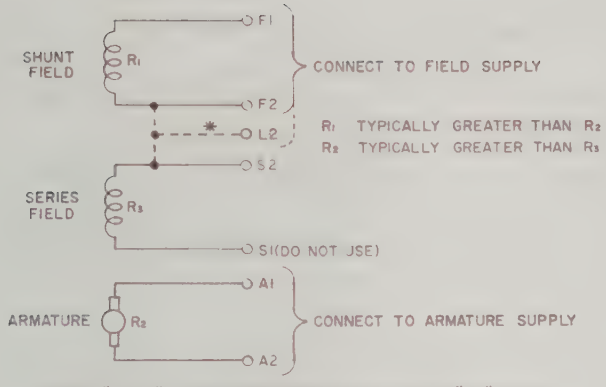
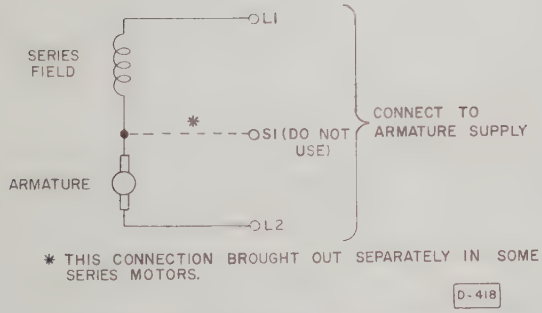
*See the schematic diagram at the back of this manual for individual pin connections.



TYPICAL SHUNT MOTOR



TYPICAL COMPOUND MOTOR



TYPICAL SERIES OR UNIVERSAL MOTOR (NON-REVERSING)

Fig. 2.1. Common Motors Operated from Model 4111 Control Unit

CAUTION

The female insert (20-7S) is fabricated in two pieces and will separate easily. Hold the insert together while removing it from the shell. Tape the two pieces together after removal to prevent separation.

Fasten the connector shells to the chassis--polarizing key up.

Replace the inserts in the shells. The male insert (20-7P) is for J3 and the female insert (20-7S) is for J4. Install the retaining rings and make sure they snap into the groove cut in the inside of the shell. The ring must be seated in the groove for the plug and receptacle to mate properly.

Two wires with terminal lugs leave the harness approximately at its midpoint. Connect them to the terminal board (TB-1) located directly behind the indicator synchro(s). Connect the gray wires together and the gray/white wires together.

Connect the harness to the synchro(s) as shown on the schematic diagram at the back of this manual.

The indicator unit synchro(s) may be adjusted to align the pointer(s) as desired. Loosen the hold-down buttons slightly and rotate the synchro body. Tighten the hold-down buttons.

WARNING

LINE VOLTAGE IS PRESENT ON THE SYNCHRO TERMINALS WHEN THE POWER SWITCH IS ON.

2.4 Operation

2.4.1 Preliminary

Before applying power to the control unit, place the front-panel controls in the following positions.

SWITCH	POSITION
POWER	OFF
FORWARD-REVERSE	Center-off
SPEED CONTROL	OFF

Make sure that the positioner control cable is attached to the proper connector.

2.4.2 Functions of Controls

The following is a brief description of each control and its function.

POWER Switch--applies ac power to the unit.

FORWARD-REVERSE Switch--used to select the direction in which the motor will run. Mechanical latching prevents rapid switching between the FORWARD and REVERSE positions. Do not attempt to defeat its purpose.

SPEED CONTROL--determines the speed at which the motor is driven. When it is in the OFF position, the motor is stopped. It is recommended that this control be placed at zero when the FORWARD-REVERSE or POWER switch is operated.

2.4.3 Checkout

Connect the power cord to an ac source capable of supplying 15 amperes. Be sure to connect the ground conductor of the power cord to the system ground of the ac source.

Energize the unit. The POWER lamp will glow to indicate power is applied.

Move the direction switch to FORWARD and the SPEED CONTROL to 5. The drive motor should drive the antenna clockwise. If the driven axis is elevation, the elevation angle should increase.

If travel past a limit will cause damage to the positioner or antenna, manually check the limit switches before the limits are reached.

Allow the drive motor to run until a limit is reached. At this point, the motor should stop.

Move the SPEED CONTROL to zero and the direction switch to REVERSE. Turn the SPEED CONTROL to 5 and the drive motor should run until the reverse (counter-clockwise) limit is reached.

If the driven axis is not equipped with limit switches and if jumpers have been connected per paragraph 2.1.1, the drive motor should run continuously in the direction selected by the FORWARD-REVERSE switch, and at the speed determined by the setting of the SPEED CONTROL.

CHAPTER 3
DETAILED DESCRIPTION

Component-designation references in this section are made to the schematic diagram at the back of this manual.

3.1 Armature and Direction Circuits

Line voltage is applied to variable autotransformer T-1 through connector J-1, switch S-1, and fuse F-1. The output of T-1 is applied directly to a full-wave silicon-diode bridge consisting of CR-5 through CR-8.

Switch S-2 determines the polarity of the voltage to be applied to the drive-motor armature and hence its direction of rotation. The armature is connected to the supply through the contacts of relay K-1. When a limit switch in the positioner opens (see paragraph 3.3), relay K-1 is de-energized and a 5-ohm resistor (R-1) is connected across the armature. This resistor provides rapid dynamic braking of the armature. The value of R-1 is chosen to provide maximum deceleration of the armature while at the same time limiting the braking torque to a safe value in order to prevent possible mechanical damage to the test antenna mounted on the positioner.

3.2 Field-Supply Circuit

Diodes CR-1 through CR-4 constitute the field supply, which is powered directly from the ac line. In addition to supplying a constant full-wave-rectified field voltage to the drive motor in the positioner, this supply provides the operating voltage for K-1.

3.3 Limit Switch Circuit

The field supply furnishes operating voltage for the limit-switch circuit. Normally closed switches in the antenna positioner hold in relay K-1 until a limit is reached. At such time, relay K-1 is de-energized and the drive motor is braked to a stop.

Assume that operation is in progress and the antenna is being rotated clockwise (forward). Relay K-1 is held in by the forward limit switch. The drive motor

continues to run until the preset limit is reached and the switch opens releasing K-1. Resistor R-1 is connected across the armature braking it to a stop. A similar action takes place when S-2 is in REVERSE. Note that when S-2 is placed in the center (off) position, relay K-1 is released.

When jumpers are connected on TB-2, relay K-1 is held in as long as S-2 is in the FORWARD or REVERSE position. Dynamic braking takes place when S-2 is moved to the center position.

3.4 Indicator Unit

Six basic models of the Scientific-Atlanta Series 4400 Indicator Units are offered for use with the control unit. A brief description of each model follows.

3.4.1 Model 4401

The Model 4401 Indicator Unit has a single pointer driven by a synchro receiver which is electrically connected to a synchro transmitter normally linked 1:1 with the mechanical motion being monitored. Thus, one complete cycle of the monitored motion results in one revolution of the pointer (360°). To change the relative position of the pointer with respect to the monitored motion, energize the system and turn the set knob until the desired setting is obtained. The standard dial is calibrated 0 to 360 degrees in two-degree increments. Accuracy of the 4401 is ±1 degree.

3.4.2 Model 4402

The Model 4402 Indicator Unit has two concentric indicator pointers driven by a single synchro receiver. The red pointer is directly connected to the synchro and indicates on the 0- to 10-degree outer scale of the dial in 0.1-degree increments. The black pointer is connected to the synchro at a ratio of 1:36 and indicates on the 0- to 360-degree inner scale of the dial in 10-degree increments. The synchro transmitter is normally connected to the monitored motion at a ratio of 36:1. Thus, 10 degrees of monitored motion produces 360 degrees of rotation of the synchro transmitter, synchro receiver and red pointer (indicating 10 degrees on the outer scale), and 10 degrees of rotation of the black pointer. To change the relative position of the pointers with respect to the monitored motion, energize the system and turn the set knob until the desired setting is obtained. Accuracy of the 4402 is ±0.03 degree.

3.4.3 Model 4403

The Model 4403 Indicator Unit has two concentric pointers, each driven by individual synchros. The red pointer indicates on the 0- to 10-degree outer scale in 0.1-degree increments. Its synchro receiver is connected to a synchro transmitter that is normally geared 36:1 with respect to the monitored motion. Thus, a 10-degree rotation of the monitored motion results in one revolution of the red pointer, indicating 10 degrees. The black pointer indicates on the 0- to 360-degree inner scale in 10-degree increments. Its synchro receiver is connected to a synchro transmitter that is normally geared 1:1 with the monitored motion. Thus, a 360-degree rotation of the monitored motion results in one revolution of the black pointer indicating 360 degrees. To change the relative positions of the pointers with respect to the monitored motion, it is necessary to set the black pointer first. Energize the system, press the set knob, and turn it to set the pointer. Release the pressure and turn the knob to set the red pointer. Accuracy of the 4403 is ±0.03 degree. Variations of connections and mechanical linkages are possible, i.e., the red and black pointers could be used to indicate in two independent systems.

3.4.4 Models 4404, 4405, and 4406

Models 4404, 4405, and 4406 Indicator Units are essentially the same as Models 4401, 4402, and 4403, respectively, except for the omission of the set knob and slip clutches. The setting of the pointers with respect to the monitored motion is changed by rotating the associated synchro(s).

CHAPTER 4
MAINTENANCE

4.1 General

Should a malfunction occur in the operation of the equipment, a visual check of all cables, connectors, relays, and switches should be made. Table 4.1 describes some malfunctions and corrective measures.

4.2 Relays

If a relay contact is suspected as a possible source of trouble, a resistance check should be made through the closed contacts. Remove all connections to the relay. Connect an ohmmeter across the suspected contacts, and energize the coil from an external source. Contact resistance should be on the order of a fraction of an ohm and should remain constant throughout each of ten normal operations.

4.3 Limit Switch Circuit

Periodically check the limit switches in the antenna positioner for proper operation. They should be replaced if their operation becomes erratic. Refer to the positioner instruction manual for replacement information.

4.4 Variable Autotransformer

Variable autotransformer T-1 has a stabilized brush track. If cleaning becomes necessary use only a soft cloth and a safe solvent, such as alcohol or "white" (nonleaded) gasoline. Do not use abrasives; their action may destroy the stabilized surface.

Normally, brushes will last indefinitely. Rapid brush wear is an almost certain sign of overload, although the presence of an abrasive dust can accelerate wear of both brush and brush track. Brush extension is limited to prevent contact between the metal brush shell and the winding. Operation of the brush beyond its extension limit results in arcing, indicated by a voltage drop under load. Replace brushes before this limit is reached. Refer to the parts list in this manual for the brush assembly replacement part number.

To replace the brush assembly, rotate the top plate to clear the retaining pins. Proper brush insertion is indicated by a click, or detent action, as the long axis of the top plate is aligned with the retaining pins.

Newly installed or reinstalled brushes must be correctly seated for proper operation. With power off, a few swings of the brush over the abrasive side of a piece of crocus cloth resting on the brush track will effectively mate brush and track. Remove the crocus cloth and brush loose carbon from the brush track before applying power.

4.5 Indicator Unit

The indicator unit is permanently lubricated at the factory and does not require lubrication. It is recommended that it be returned to the factory for repair if necessary.

CHAPTER 5
REPLACEMENT PARTS LIST

This chapter contains the replacement parts list for the positioner control unit.

Changes may have been made by hand to the following replacement parts list and/or schematic diagram. In general, these changes are appropriate only to the instrument whose serial number appears on the frontispiece of this manual. In addition, an Instruction Manual Change Notice sheet may be inserted immediately following the frontispiece. This sheet describes production changes made to the equipment after the manual was printed. Check this sheet to see if any of the changes apply to your equipment.

Common components may differ from those shown in the parts list. This difference is due to the substitution of a more current part during assembly. In such cases, the type shown in the parts list or the type removed may be used as a replacement.

When ordering parts from Scientific-Atlanta, be sure to include the equipment model number, equipment serial number, and a description of the part.

MANUFACTURERS' CODE LETTERS

Code	Manufacturer
ABE	Amphenol-Borg
AHH	Arrow, Hart & Hegeman
BUS	Bussman
CH	Cutler-Hammer
CM	Cinch
DI	Dialight
GE	General Electric
GR	General Radio
HH	Harvey Hubbell
L	Littelfuse
O	Ohmite
PB	Potter & Brumfield
SA	Scientific-Atlanta
XX	Any brand diode or transistor which meets JEDEC standards

PARTS LIST

MODEL 4111
POSITIONER CONTROL UNIT

Comp. Desig.	Total	Description	Mfr.*	Mfr. Part No.
A-1**	1	Subassembly, position indicator unit	SA	Series 4400
CR-1 thru CR-4	4	Diode, silicon	XX	1N2484
CR-5 CR-6	2	Diode, silicon	XX	1N3211
CR-7 CR-8	2	Diode, silicon	XX	1N3211R
CR-9 CR-10	2	Surge protector	GE	6RS21SA7D7
DS-1	1	Lamp, neon-glow	GE	NE-51
F-1 F-2	2	Fuse, 3AG, slow blow, or 3AB, medium lag. See text, paragraph 2.1.2, for value.	L L	Series 313000 Series 314000
J-1	1	Connector, receptacle, male, 3 pins	HH	7486
J-2	1	Connector, receptacle, female, 22 contacts	ABE	MS3102A-28-11S(W
J-3	1	Connector, receptacle, male, 8 pins	ABE	MS3102A-20-7P
J-4	1	Connector, receptacle, female, 8 contacts	ABE	MS3102A-20-7S
K-1	1	Relay, SPDT, 110v dc coil	PB	PR5D
P-1	1	Connector, plug, female, 3 contacts	HH	7484
P-2	1	Connector, cable, male, 22 pins	ABE	MS3106A-28-11P(W
P-3	1	Connector, cable, male, 8 contacts	ABE	MS3106A-20-7P
P-4	1	Connector, cable, male, 8 pins	ABE	MS3106A-20-7P
R-1	1	Resistor, fixed, wirewound, 5 ohms ±10%, 50w	O	0400
S-1	1	Switch, toggle, SPST	CH	7500-K14
S-2	1	Switch, toggle, heavy duty, 3-pole, 3-position, positive center off	AHH	80983
T-1	1	Transformer, variable, power, 120v ac, 50/60 cps input	GR	W5 (COTAL)

*See "Manufacturers' Code Letters," page 5-1.
**Optional.

Comp. Desig.	Total	Description	Mfr.*	Mfr. Part No.
--	1	Replacement brush assembly for T1	GR	VB2
TB-1	1	Terminal strip, barrier, 2-terminal	CM	2-140
TB-2	1	Terminal strip, barrier, 3-terminal	CM	3-140
XDS-1	1	Pilot lamp assembly, red cap, with internal 56,000-ohm, 1/3-watt resistor	DI	521308-991
XF-1 XF-2	2	Fuseholder, panel mounting	BUS	HKP

*See "Manufacturers' Code Letters," page 5-1.

APPLICATION		
QTY REQD	NEXT ASSY	USED ON
		J2-10

REVISIONS			
SYM	DESCRIPTION	DATE	APPROVED

TO SYNCHRO TRANSMITTERS

B
A
G
H
F
C

GRAY
YELLOW
ORANGE
BROWN
WH/GRAY

J4
MS3106A-20-7S

S1
S2
S3
23TR6
1:1
R1
R2

TB1
2
1
WH/GRAY
GRAY

OFF
S1
F1
LINE

J1
POWER
INPUT 115V RMS

CR11
CR12
IN4721
CR13
CR14

B
R7
25Ω, 5W

C2
1100MF
50V
C1
1100MF
50V

CR16
IN2484
Q1
40251
Q2
40250
R1
270Ω
½W
R2
270Ω
1W
Q3
2N2270
CR15
IN4735
R3
820Ω
½W
R4
870Ω
R5
500Ω
R6
870Ω

DS1
POWER

T1
2
3
SPEED CONTROL
TAP
4

A
DRIVE
VARIABLE
CONSTANT

CR1
CR2
IN2484'S
CR3
CR4

CR5
IN3211
CR6
IN3211
CR7
IN3211R
CR8
IN3211R
CR10
6RS21SA
7D7

S3
CR9
6RS21SA
7D7

S2
FORWARD
REVERSE

K1
110V
DC
R1
5Ω
50W

F2
MOTOR

J2
MS3102A-28-11S(W)
TB2*
1
0
2
0
3
0
D
F
H
E
G
B
C
A

TO POSITIONER
J1
(MOTORS)

P2
MS3106A-28-11P(W)

R8
5Ω, 50W

H NORMALLY OPEN CONTACT
G RELAY ARM
F NORMALLY CLOSED CONTACT

A

A
E
B
C
D

COMMON (-)

C3
10MF, 50V
C4
10MF, 50V
C5
10MF, 50V
6
10MF, 50V

J3
MS3102A-20-7S

TO CUSTOMER EQUIPMENT
J505

C
A
D
E
F
B

B

J5
MS3102A-20-7S(W)

ARMATURE FUSE DATA	
MOTOR SIZE	F2
¾ HP	8A, 3AB
⅓ HP	4A, 3AG, SB
⅛ HP	2A, 3AG, SB
1/12 HP	1.5A, 3AG, SB

NOTE:
* IF POSITIONER LIMIT SWITCHES ARE NOT USED TERMINALS 1, 2 & 3 ON TB2 MUST BE SHORTED

QTY REQ'D	ITEM	IDENTIFYING NUMBER	NOMENCLATURE OR DESCRIPTION	MATERIAL	MFR'S CODE	MAT. SPEC	SIZE

LIST OF MATERIALS OR PARTS LIST

ALL DIMENSIONS ARE IN INCHES
UNLESS OTHERWISE SPECIFIED
TOLERANCES
THREE PLACES: .005 FRACTIONS: —
TWO PLACES: .015
ONE PLACE: — ANGLES: 0° 30'
ABBREVIATIONS PER MIL-STD-12
DIMENSIONS PER MIL-STD-8
SCREW THREADS PER NBS H28 & MIL-STD-9
ELECTRICAL & ELECTRONIC SYMBOLS PER MIL-STD-15
REFERENCE DESIGNATIONS PER MIL-STD-16
FINISH: √ ROUGHNESS PER MIL-STD-10
ALL BREAKS X.XXX ± .XXX AND — WATT UNLESS OTHERWISE SPECIFIED
ALL CAPACITORS IN MICROFARADS UNLESS OTHERWISE SPECIFIED
LAST REFERENCE DESIGNATION USED
C — CR — J — K —
Q — R — S —
BREAK SHARP EDGES & CORNERS .005 TO .015
FINISH

		DATE
DR BY	Carver	11-9-67
ENGR	Mann Rudd	11-10-67
CHK	Oscar Cook II	11-10-67
MATL		
PROJ		
PROD		
APPD		
APPD		
APPD		

SCIENTIFIC-ATLANTA, INC.
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SCHEMATIC DIAGRAM POSITIONER CONTROL UNIT, MODEL 4111-(X)MOD

CODE IDENT NO.	SIZE	DRAWING NO.
10110	D	55631

SCALE	WEIGHT	SHEET

CONVERSION OF VOLTAGE AND POWER RATIOS TO DECIBELS

he basic chart below indicates the number of decibels (db) rresponding to the listed ratios of voltage or power over the nge of −20 to +20 db. For voltage or power ratios greater than ose included in the chart, the ratio can be broken down into a oduct of two numbers, the value in db for each found separately, d the two results added. Example: To convert a power ratio of 2,000:1 to db, express 2,000 as 2×10^3; the number of db corresponding to a power ratio of 2 is very nearly 3, and the number of db for a power ratio of 10^3 is 30. Therefore, the power ratio of 2,000:1 is approximately 30 db + 3 db = 33 db. In the lower right-hand corner of the chart db values for voltage and power ratios of integral powers of 10 are given.

Voltage Ratio	Power Ratio	−db+	Voltage Ratio	Power Ratio	Voltage Ratio	Power Ratio	−db+	Voltage Ratio	Power Ratio	Voltage Ratio	Power Ratio	−db+	Voltage Ratio	Power Ratio
1.000	1.000	0	1.000	1.000	.447	.200	7.0	2.239	5.012	.200	.0398	14.0	5.012	25.12
.989	.977	.1	1.012	1.023	.442	.195	7.1	2.265	5.129	.197	.0389	14.1	5.070	25.70
.977	.955	.2	1.023	1.047	.437	.191	7.2	2.291	5.248	.195	.0380	14.2	5.129	26.30
.966	.933	.3	1.035	1.072	.432	.186	7.3	2.317	5.370	.193	.0372	14.3	5.188	26.92
.955	.912	.4	1.047	1.096	.427	.182	7.4	2.344	5.495	.191	.0363	14.4	5.248	27.54
.944	.891	.5	1.059	1.122	.422	.178	7.5	2.371	5.623	.188	.0355	14.5	5.309	28.18
.933	.871	.6	1.072	1.148	.417	.174	7.6	2.399	5.754	.186	.0347	14.6	5.370	28.84
.923	.851	.7	1.084	1.175	.412	.170	7.7	2.427	5.888	.184	.0339	14.7	5.433	29.51
.912	.832	.8	1.096	1.202	.407	.166	7.8	2.455	6.026	.182	.0331	14.8	5.495	30.20
.902	.813	.9	1.109	1.230	.403	.162	7.9	2.483	6.166	.180	.0324	14.9	5.559	30.90
.891	.794	1.0	1.122	1.259	.398	.159	8.0	2.512	6.310	.178	.0316	15.0	5.623	31.62
.881	.776	1.1	1.135	1.288	.394	.155	8.1	2.541	6.457	.176	.0309	15.1	5.689	32.36
.871	.759	1.2	1.148	1.318	.389	.151	8.2	2.570	6.607	.174	.0302	15.2	5.754	33.11
.861	.741	1.3	1.161	1.349	.385	.148	8.3	2.600	6.761	.172	.0295	15.3	5.821	33.88
.851	.724	1.4	1.175	1.380	.380	.145	8.4	2.630	6.918	.170	.0288	15.4	5.888	34.67
.841	.708	1.5	1.189	1.413	.376	.141	8.5	2.661	7.079	.168	.0282	15.5	5.957	35.48
.832	.692	1.6	1.202	1.445	.372	.138	8.6	2.692	7.244	.166	.0275	15.6	6.026	36.31
.822	.676	1.7	1.216	1.479	.367	.135	8.7	2.723	7.413	.164	.0269	15.7	6.095	37.15
.813	.661	1.8	1.230	1.514	.363	.132	8.8	2.754	7.586	.162	.0263	15.8	6.166	38.02
.804	.646	1.9	1.245	1.549	.359	.129	8.9	2.786	7.762	.160	.0257	15.9	6.237	38.90
.794	.631	2.0	1.259	1.585	.355	.126	9.0	2.818	7.943	.159	.0251	16.0	6.310	39.81
.785	.617	2.1	1.274	1.622	.351	.123	9.1	2.851	8.128	.157	.0246	16.1	6.383	40.74
.776	.603	2.2	1.288	1.660	.347	.120	9.2	2.884	8.318	.155	.0240	16.2	6.457	41.69
.767	.589	2.3	1.303	1.698	.343	.118	9.3	2.917	8.511	.153	.0234	16.3	6.531	42.66
.759	.575	2.4	1.318	1.738	.339	.115	9.4	2.951	8.710	.151	.0229	16.4	6.607	43.65
.750	.562	2.5	1.334	1.778	.335	.112	9.5	2.985	8.913	.150	.0224	16.5	6.683	44.67
.741	.550	2.6	1.349	1.820	.331	.110	9.6	3.020	9.120	.148	.0219	16.6	6.761	45.71
.733	.537	2.7	1.365	1.862	.327	.107	9.7	3.055	9.333	.146	.0214	16.7	6.839	46.77
.724	.525	2.8	1.380	1.905	.324	.105	9.8	3.090	9.550	.145	.0209	16.8	6.918	47.86
.716	.513	2.9	1.396	1.950	.320	.102	9.9	3.126	9.772	.143	.0204	16.9	6.998	48.98
.708	.501	3.0	1.413	1.995	.316	.100	10.0	3.162	10.000	.141	.0200	17.0	7.079	50.12
.700	.490	3.1	1.429	2.042	.313	.0977	10.1	3.199	10.23	.140	.0195	17.1	7.161	51.29
.692	.479	3.2	1.445	2.089	.309	.0955	10.2	3.236	10.47	.138	.0191	17.2	7.244	52.48
.684	.468	3.3	1.462	2.138	.306	.0933	10.3	3.273	10.72	.137	.0186	17.3	7.328	53.70
.676	.457	3.4	1.479	2.188	.302	.0912	10.4	3.311	10.96	.135	.0182	17.4	7.413	54.95
.668	.447	3.5	1.496	2.239	.299	.0891	10.5	3.350	11.22	.133	.0178	17.5	7.499	56.23
.661	.437	3.6	1.514	2.291	.295	.0871	10.6	3.388	11.48	.132	.0174	17.6	7.586	57.54
.653	.427	3.7	1.531	2.344	.292	.0851	10.7	3.428	11.75	.130	.0170	17.7	7.674	58.88
.646	.417	3.8	1.549	2.399	.288	.0832	10.8	3.467	12.02	.129	.0166	17.8	7.762	60.26
.638	.407	3.9	1.567	2.455	.285	.0813	10.9	3.508	12.30	.127	.0162	17.9	7.852	61.66
.631	.398	4.0	1.585	2.512	.282	.0794	11.0	3.548	12.59	.126	.0159	18.0	7.943	63.10
.624	.389	4.1	1.603	2.570	.279	.0776	11.1	3.589	12.88	.125	.0155	18.1	8.035	64.57
.617	.380	4.2	1.622	2.630	.275	.0759	11.2	3.631	13.18	.123	.0151	18.2	8.128	66.07
.610	.372	4.3	1.641	2.692	.272	.0741	11.3	3.673	13.49	.122	.0148	18.3	8.222	67.61
.603	.363	4.4	1.660	2.754	.269	.0724	11.4	3.715	13.80	.120	.0145	18.4	8.318	69.18
.596	.355	4.5	1.679	2.818	.266	.0708	11.5	3.758	14.13	.119	.0141	18.5	8.414	70.79
.589	.347	4.6	1.698	2.884	.263	.0692	11.6	3.802	14.45	.118	.0138	18.6	8.511	72.44
.582	.339	4.7	1.718	2.951	.260	.0676	11.7	3.846	14.79	.116	.0135	18.7	8.610	74.13
.575	.331	4.8	1.738	3.020	.257	.0661	11.8	3.890	15.14	.115	.0132	18.8	8.710	75.86
.569	.324	4.9	1.758	3.090	.254	.0646	11.9	3.936	15.49	.114	.0129	18.9	8.811	77.62
.562	.316	5.0	1.778	3.162	.251	.0631	12.0	3.981	15.85	.112	.0126	19.0	8.913	79.43
.556	.309	5.1	1.799	3.236	.248	.0617	12.1	4.027	16.22	.111	.0123	19.1	9.016	81.28
.550	.302	5.2	1.820	3.311	.246	.0603	12.2	4.074	16.60	.110	.0120	19.2	9.120	83.18
.543	.295	5.3	1.841	3.388	.243	.0589	12.3	4.121	16.98	.108	.0118	19.3	9.226	85.11
.537	.288	5.4	1.862	3.467	.240	.0575	12.4	4.169	17.38	.107	.0115	19.4	9.333	87.10
.531	.282	5.5	1.884	3.548	.237	.0562	12.5	4.217	17.78	.106	.0112	19.5	9.441	89.13
.525	.275	5.6	1.905	3.631	.234	.0550	12.6	4.266	18.20	.105	.0110	19.6	9.550	91.20
.519	.269	5.7	1.928	3.715	.232	.0537	12.7	4.315	18.62	.104	.0107	19.7	9.661	93.33
.513	.263	5.8	1.950	3.802	.229	.0525	12.8	4.365	19.05	.102	.0105	19.8	9.772	95.50
.507	.257	5.9	1.972	3.890	.227	.0513	12.9	4.416	19.50	.101	.0102	19.9	9.886	97.72
.501	.251	6.0	1.995	3.981	.224	.0501	13.0	4.467	19.95	.100	.0100	20.0	10.000	100.00
.496	.246	6.1	2.018	4.074	.221	.0490	13.1	4.519	20.42					
.490	.240	6.2	2.042	4.169	.219	.0479	13.2	4.571	20.89	10^{-2}	10^{-3} 10^{-4}	30 40	10^{2}	10^{3} 10^{4}
.484	.234	6.3	2.065	4.266	.216	.0468	13.3	4.624	21.38					
.479	.229	6.4	2.089	4.365	.214	.0457	13.4	4.677	21.88	10^{-3}	10^{-5} 10^{-6}	50 60	10^{3}	10^{5} 10^{6}
.473	.224	6.5	2.113	4.467	.211	.0447	13.5	4.732	22.39		10^{-7}	70		10^{7}
.468	.219	6.6	2.138	4.571	.209	.0437	13.6	4.786	22.91	10^{-4}	10^{-8} 10^{-9}	80 90	10^{4}	10^{8} 10^{9}
.462	.214	6.7	2.163	4.677	.207	.0427	13.7	4.842	23.44					
.457	.209	6.8	2.188	4.786	.204	.0417	13.8	4.898	23.99	10^{-5}	10^{-10} 10^{-11}	100 110	10^{5}	10^{10} 10^{11}
.452	.204	6.9	2.213	4.898	.202	.0407	13.9	4.955	24.55	10^{-6}	10^{-12}	120	10^{6}	10^{12}

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